Patents Form 1/77

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The Patent Office

1/77

15MAY98 E360821-1 D02884
P01/7700 25.00 - 9810405.2

Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office
Cardiff Road
Newport
Gwent NP9 1RH

1. Your reference

P21398/JLU/JAL

2. Patent application number *(The Patent Office will fill in this part)*

15 MAY 1998 **9810405.2**

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

Measurement Devices Limited
Silverburn Crescent
Bridge of Don
ABERDEEN
AB23 8EW

Patents ADP number *(if you know it)*

If the applicant is a corporate body, give the country/state of its incorporation

United Kingdom 4118527001

4. Title of the invention

"Survey Apparatus"

5. Name of your agent *(if you have one)*

Murgitroyd & Company

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

373 Scotland Street
GLASGOW
G5 8QA

Patents ADP number *(if you know it)*

1198013

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*

Yes

a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
See note (d))

Patents Form 1/77

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form	–
Description	11
Claim(s)	–
Abstract	–
Drawing(s)	0

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10. If you are also filing any of the following, state how many against each item.

Priority documents	–
Translations of priority documents	–
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	–
Request for preliminary examination and search *(Patents Form 9/77)*	–
Request for substantive examination *(Patents Form 10/77)*	–
Any other documents *(please specify)*	–

11. I/We request the grant of a patent on the basis of this application.

Signature MURGITROYD & COMPANY Date 15.5.98

12. Name and daytime telephone number of person to contact in the United Kingdom: Jamie Allan 01224 706616

Warning

After an application for a patent has been filed, the Comptroller of the Patent Office will consider whether publication or communication of the invention should be prohibited or restricted under Section 22 of the Patents Act 1977. You will be informed if it is necessary to prohibit or restrict your invention in this way. Furthermore, if you live in the United Kingdom, Section 23 of the Patents Act 1977 stops you from applying for a patent abroad without first getting written permission from the Patent Office unless an application has been filed at least 6 weeks beforehand in the United Kingdom for a patent for the same invention and either no direction prohibiting publication or communication has been given, or any such direction has been revoked.

Notes

a) If you need help to fill in this form or you have any questions, please contact the Patent Office on 0645 500505.

b) Write your answers in capital letters using black ink or you may type them.

c) If there is not enough space for all the relevant details on any part of this form, please continue on a separate sheet of paper and write "see continuation sheet" in the relevant part(s). Any continuation sheet should be attached to this form.

d) If you have answered 'Yes' Patents Form 7/77 will need to be filed.

e) Once you have filled in the form you must remember to sign and date it.

f) For details of the fee and ways to pay please contact the Patent Office.

T.V. ALS PATENT APPLICATION

Background

There is a need to obtain, by passive means, X, Y, Z co-ordinate information to enable Surveyors and Engineers to "visualise" and plot "Topographic" features, contours, cross-sections and heights.
Applications would include but not be restricted to:-

Map making
Obstacle dimensioning
Construction
Mining and Quarrying

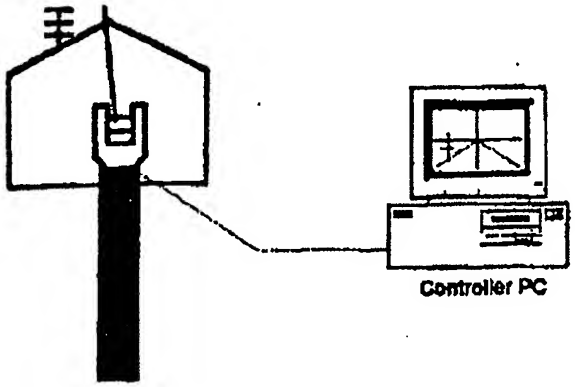
The Apparatus

The equipment comprises:-

1. A laser range finder for passive distance measurements to target objects including earth, vegetation, wood, rock and metals.
2. A motorised "pan and tilt" yoke complete with angle measuring encoders to detect the direction and elevation of the targets.
3. A digital video camera with zoom capabilities to "visualise" the target area and to provide scan and pointing angle control.
4. An electronic means of remotely and robotically controlling the apparatus either by direct cabling or telemetry.
5. An elevating mast to raise the apparatus to a height sufficient to give a commanding view of the target area.
6. A Windows based software suite which enables:-

    i) Remote control of the apparatus by cable or telemetry
    ii) Combination of digital video and measured data to be viewed, calculations to be made and the data recorded.

General Arrangement of Apparatus



Statement of Invention

According to the present invention there is provided a survey apparatus comprising a range finder, a camera and an image processor capable of processing image and range and optionally angle signals in real time to construct a 3-dimensional image from said signals which can be displayed in real time.

The camera is preferably a video camera, and more preferably a digital video camera. The range finder is preferably a laser range finder.

The apparatus can optionally calculate distance to specified points and incorporate such distance measurements into the 3-dimensional image.

The apparatus preferably has motorised controllers for pan and tilt of the range finder and/or camera.

The image is preferably digitised.

The apparatus is preferably remotely controllable. It can also incorporate means to enable the calculation of distance to particular image points, and can record all such information for later viewing and/or analysis.

The apparatus optionally incorporates Global Positioning System (GPS) and/or a gyroscope to provide positional information and/or tilt angles. These can be digitised to provide data to the image processor.

The apparatus can optionally be mounted on an elevating platform, telescopic elevating tube, telescopic arm, robatic arm or the like. This provides the apparatus with a larger viewing area.

The elevating platform or the like is typically capable of 360° rotation. This provides a complete viewing range.

The apparatus allows data gathering from within a vehicle to construct a digital terrain model of the terrain surrounding the vehicle.

Mode of Operation

The operator views the target area via the computer screen. By pointing and clicking using a pointing device the apparatus pans, tilts and ranges to the indicated selected target position.
Immediately the range, bearing and vertical angle is returned to the computer where it is displayed in a convenient overlay position on the video display.
The operator can also select an area of interest to be surveyed by tracing a rectangle or polygon on the computer video screen using a mouse.
The selected area can then be automatically "in-filled" with continuous measurements at a given horizontal and vertical increments with no further operator intervention.
A visual display of the data collected is presented to the operator at the computer by plotting the graphical points over the video image.

Iconised function buttons are also overlayed on the video image allowing access to further software functions. These include but are not limited to:-

1. Remote heighting between selected points.
2. Distance and gradient between selected points.
3. Cross section or profile through a series of selected points.
4. Enclosed planimetric area calculated from a polygon drawn on screen.

Methodology

A digital camera is calibrated and collimated to a laser distance meter. The laser/camera is in turn calibrated and collimated to a pan and tilt mechanism which also measures the horizontal and vertical angle directions of the apparatus

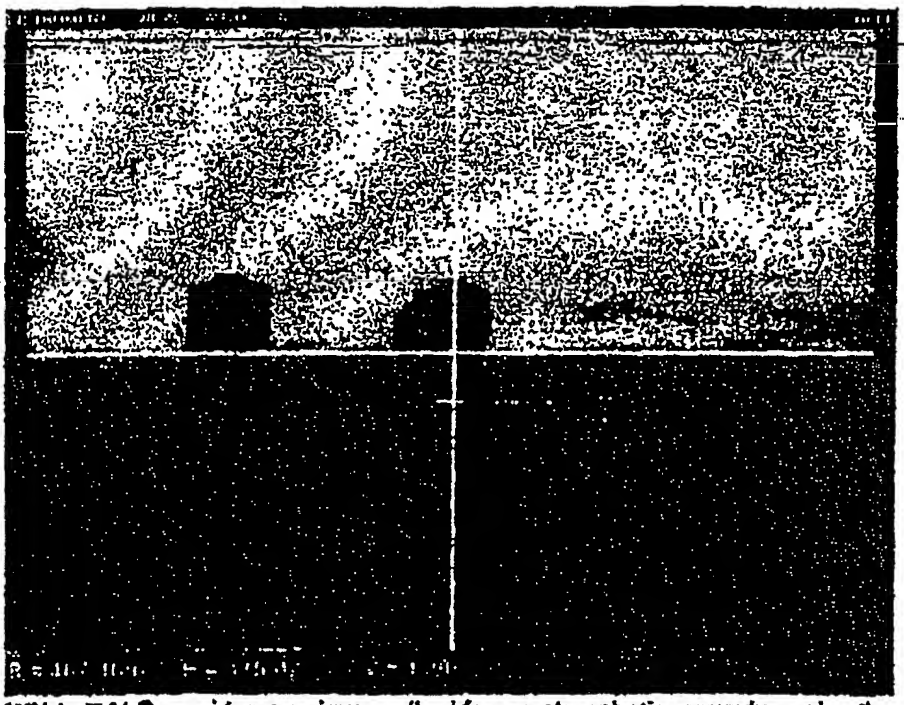
Because the relationship between the pixels of the image and the movement of the pan and tilt mechanism is precisely known, it is possible to use a computer pointing device to select the pixel position in the video frame of any target in view. By converting the X,Y position of the selected pixel position, a precise horizontal and vertical angle movement can be issued to the powered pan and tilt device, directing the laser to illuminate and measure to the previously selected target on the video image.

By taking a series of measurements, in this way, calculations can be made to determine the height, gradient and distance between any of the selected positions.

The apparatus is best deployed for maximum effect on an elevating platform or mounted on a telescopic elevating tube. This gives a more commanding view of any target area. The instrument cannot be levelled in an elevated position therefore the degree of "tilt" of the elevating platform/cube is measured electronically in 2 axes (with apparatus such as the MDL Trimcube). By also detecting the direction of the axes of the tilt, using a compass or gyroscope corrections can be made to the apparatus to "de-skew" the measurements to give correct horizontal and vertical direction measurements.

connaissance Laser Auto-Scanning
ystem RLAS
Patent applied for

WORLD LEADERS IN LASER MEASUREMENT TECHNOLOGY



MDL's RALS provides a unique method for remote, robotic surveying using the latest laser, video and surveying techniques. The system also incorporates real-time ground modelling and contouring. The **RALS** is therefore ideal for gap measurement and river crossing surveys.

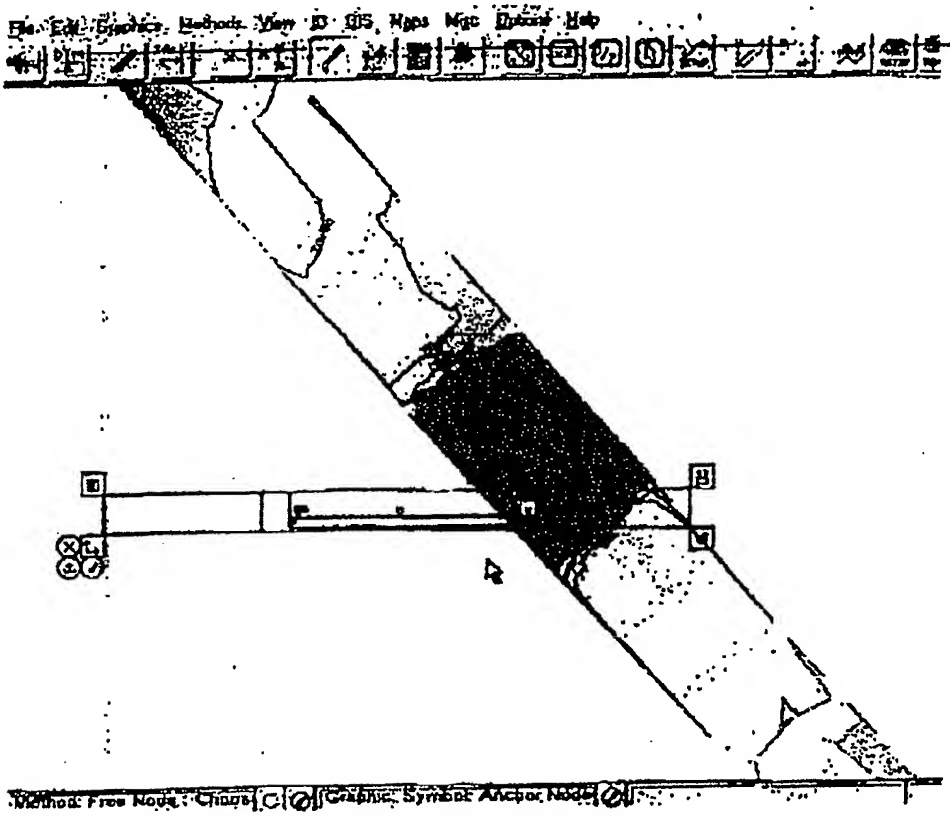
The Need For Remote Control

The RALS can be used for a wide variety of applications in hostile and/ or hazardous environments. Recent improvements made to the MDL ALS ensure operators can survey an area of interest from a safe, remote environment. Integrated real-time ground modelling and contouring provides instant results and allows for further manipulation for calculating best-fit designs, volumes, slope analysis, etc.

Integrated Ground Modelling Software

Normally, any data collected has to be stored and then transferred to a third party software package for post-processing. The RALS system has the unique capability to by-pass this stage and thus allows the operator to create a map of the data, in the field, immediately. Further to this, the ground model is updated dynamically for each new point surveyed and therefore identifies any potential [illegible]ors and areas that may require further in-fill.

[illegible]nce the ground model has been formed design templates can be placed over the gap to assess the type of equipment needed to cross the obstacle.



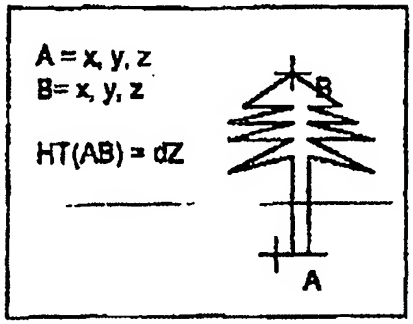
The whole surveying operation can be carried out discretely and in a fraction of the time normally taken for such surveys. Such surveys can be carried out from one or more positions and the data integrated. When completed the whole of the data set can be transferred to other software packages in a variety of formats including DXF™

Extra Software Functions

Additional functions have been created for direct measurement from the RALS. These include ***heighting between 2 points, missing distance including gradient & section profiling.*** Results are displayed directly on the video screen in a separate window.

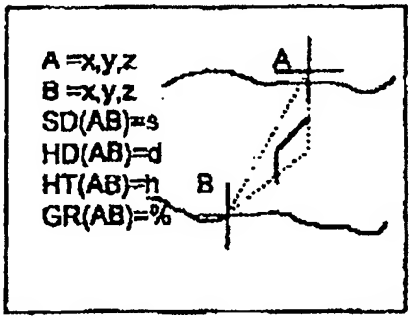
1. Height Mode

Shoot A, Shoot B
Calculate Height A to B = α



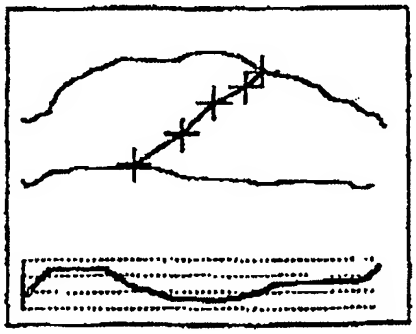
2. Difference in Distance and Height

Shoot A, Shoot B
Calculate Slope A to B
Calculate Horizontal Distance A to B
Calculate height Difference A to B
Calculate Gradient A to B



3. Profile 1 to N

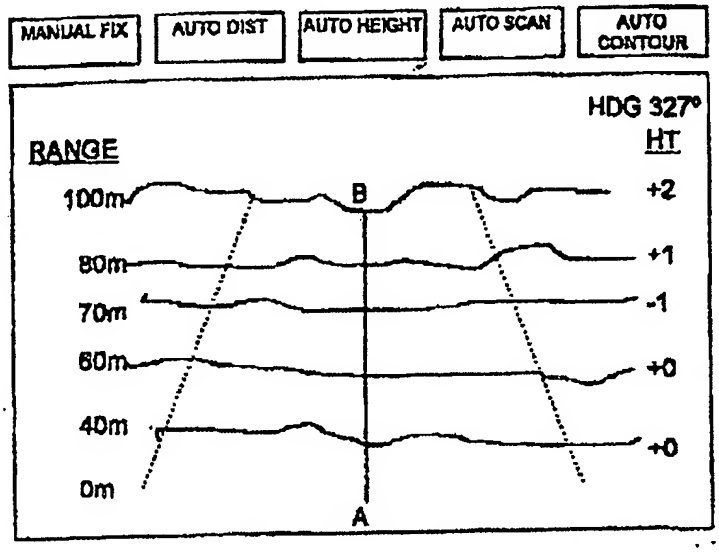
Shoot 1 to N
Scan along the profile in intervals
Plot Profile



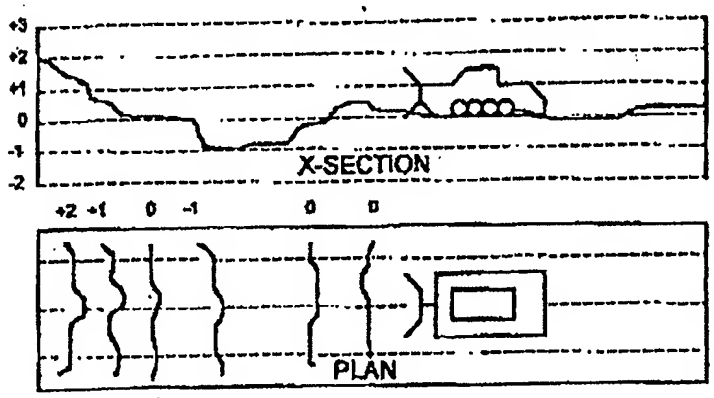
Technical Specification

Laser Module		MDL100	MDL300	DISTO
Type		Semiconductor	Semiconductor	Semiconductor
Accuracy		2cm	5cm	3mm
Resolution		1cm	2cm	1mm
Range	Passive	80m	400m	30m
	1 prism	3.5km	8km	
Eye Safety		Class 1	Class 1	Class 2
Measuring Time		1 sec.	0.4 sec.	2.5 to 10 sec.
Telescope		External with zoom 1.5 to 4x18		None
Pointing Laser	Type	Optional red spot	Optional red spot	Red spot laser
	Laser	Class 3A	Class 3A	Class 2
Angle				
Type	Electronic encoder	Standard	Standard	Standard
Accuracy		0.02°	0.02°	0.02°
Resolution		0.01°	0.01°	0.01°
Range	Vertical	-80° to +85°	-80° to +85°	-40° to +90°
	Horizontal	0° to 360°	0° to 360°	0° to 360°
Motion		Stepper driven worm & wheel drives (both axis) with manual clutch override system		
Keyboard & Display				
LCD display		Standard	Standard	Standard
Keyboard		4 X 20	4 X 20	4 x 20
Lines/ characters		Membrane	Membrane	Membrane
Data Logging				
Internal memory	RAM	128kbytes	128kbytes	128kbytes
Link to	Laptop PC	Optional	Optional	Optional
	Desktop PC	Optional	Optional	Optional
	portable palm	Optional	Optional	Optional
PCMCIA memory card, 128kbytes		Optional	Optional	Optional
Physical Data				
Temperature Range		-10°C to +45°C (-20°C to 45°C optional)		
Water & dust resistant		IP66	IP66	IP66
External battery pack		12V DC	12V DC	12V DC
Dimensions (LxWxH)		200x243x420mm	200x243x420mm	200x243x420mm
Weight		9Kg	9Kg	9Kg
	with tribach	10Kg	10Kg	10Kg

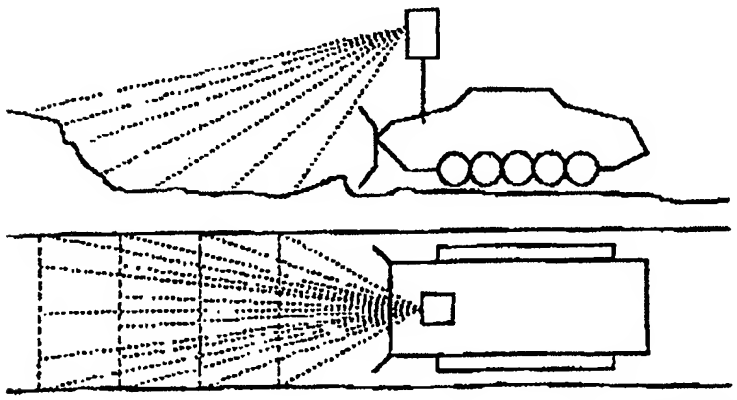
VIDEO VIEW
GRAPHICS OVERLAY ON VIDEO CORRECTED FOR PROJECTED TANK / CAMERA-HEADING



HEIGHT RELATIVE TO ORIGINAL TRACTOR POSITION
OR ABSOLUTE HEIGHT REF TO DGPS

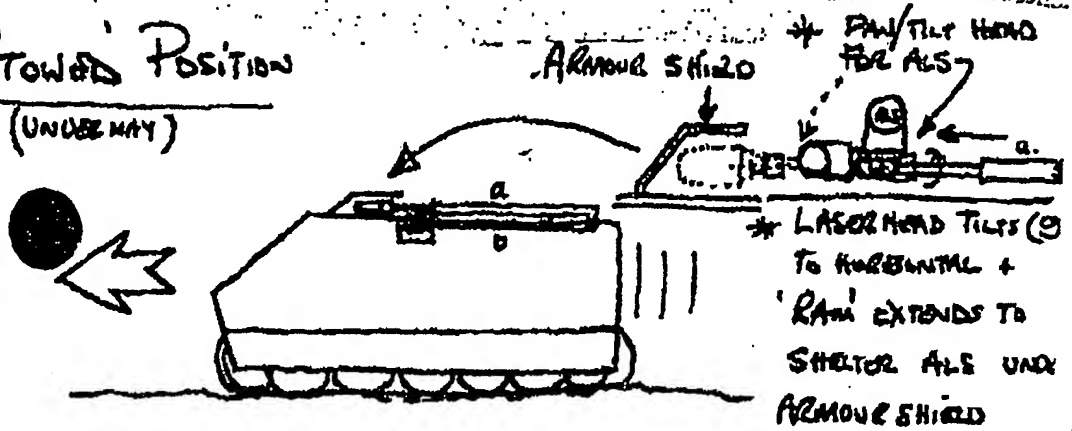


SCHEMATIC



'Stowed' Position

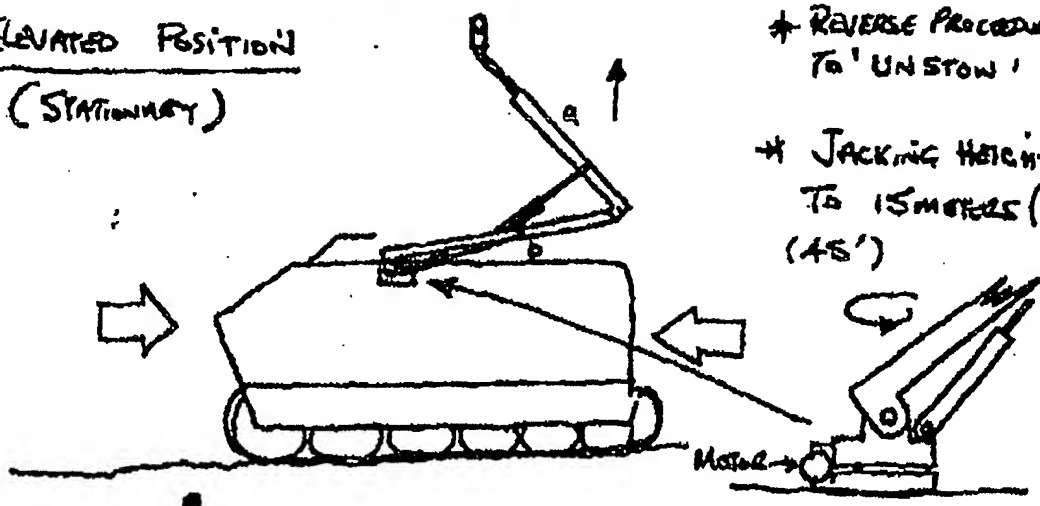
(Underway)



* Laser Head Tilts @ to horizontal + 'Ram' extends to shelter ALS under Armour Shield
* Reverse procedure to 'Unstow'

Elevated Position

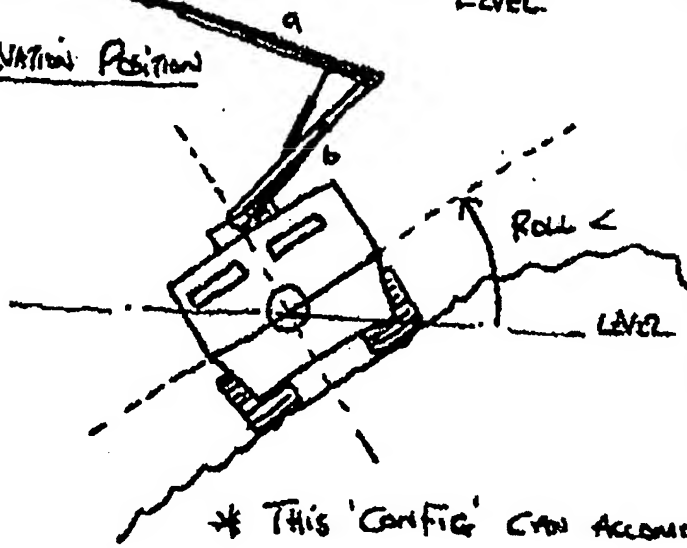
(Stationary)



* Jacking height to 15 metres (max 45')

* Rotation Joint (180 at base

Observation Position



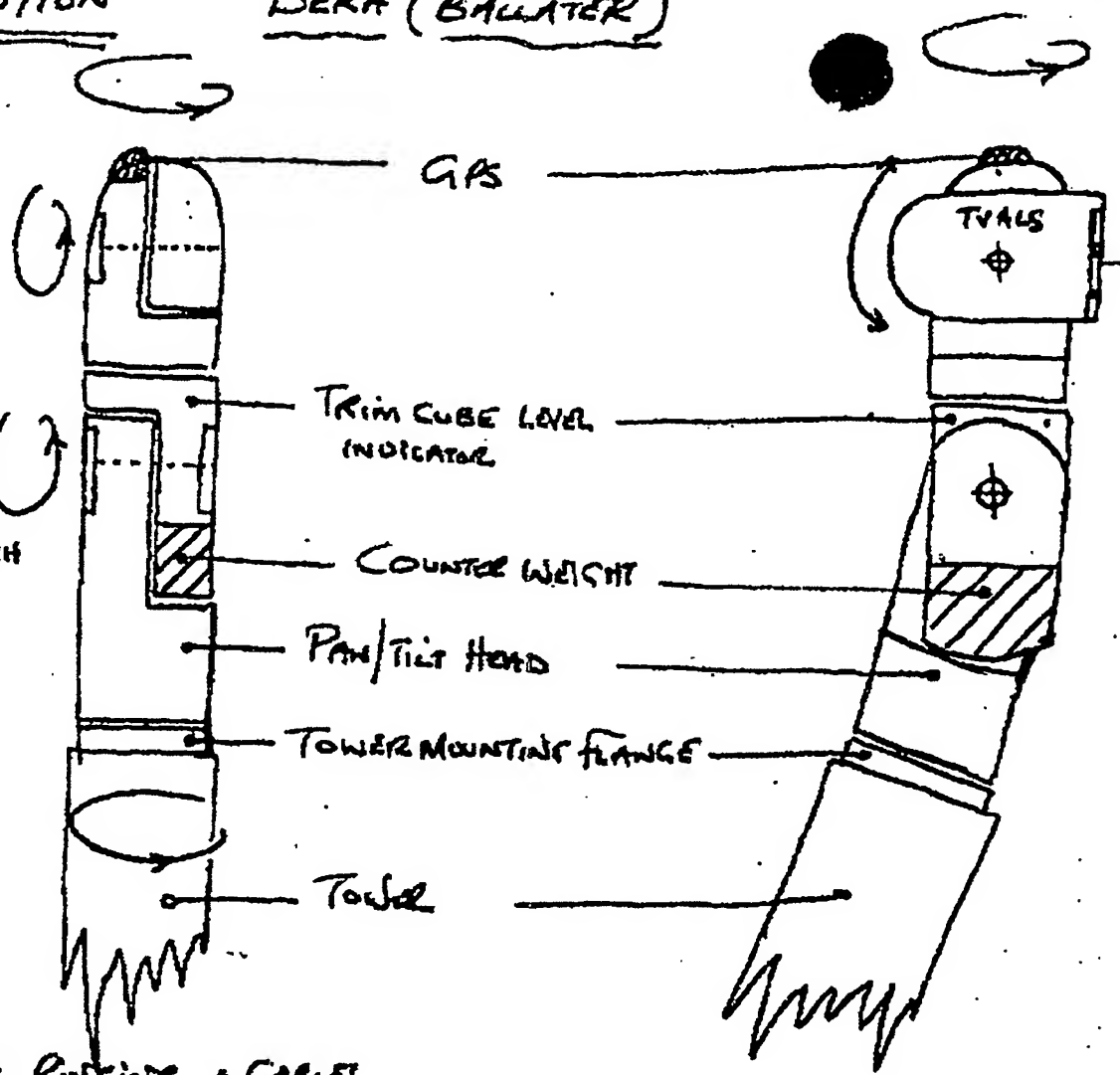
* Operator 'Rotates' arm into plane of Pitch or Roll (which ever is great
* Arm @ angle + Tilt table under ALS precisely levels inst

* This 'Config' can accomodate massive Pitch + Roll angles

TOWER TILT SOLUTION

DERA (BALATER)

* OPTIMUM DESIGN FOR RETRACTION INTO PROTECTIVE TOWER/TUBE
* METHOD: SERVO'S ROTATE PAN/TILT HEAD INTO PLANE OF ROLL/&PITCH
* PAN/TILT TO LEVEL ALS MOUNTING HEAD.
* ELECTRONIC LEVELS IN ALS MEASURE RESIDUAL DISLEVELMENT + CORRECTION APPLIED IN SOFTWARE
* MAIN PROBLEM:— SLIP RINGING + CABLES



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